Sustainable cleaning of the health care environment.

Has the current practice of cleaning the health care environment relying on the use of disinfectants and their label claims and instructions for use as best practice to maintain a clean safe health care environment worked in Canada?
Canada has second highest rate of hospital acquired infections according to world health organization report.

• The term outbreak was shocking in movies just a few years ago.

• Today outbreaks are a common and a regular event not only in hospitals but also now in long term care facilities.
Updated: Thursday, September 22, 2011


The Welland C. difficile outbreak was declared over on Friday, Aug. 5, 2011.

The Niagara Falls C. difficile outbreak was declared over on Tuesday Sep. 6, 2011.

<table>
<thead>
<tr>
<th>Report as of Thu., Sep. 22, 2011 at 10 a.m.</th>
<th>St. Catharines General</th>
<th>Greater Niagara General Site</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of cases since the outbreak declared</td>
<td>70 (up one)</td>
<td>20 (no change)</td>
<td>90</td>
</tr>
<tr>
<td>Confirmed Cases currently in-patients at the site</td>
<td>9 (down three)</td>
<td>9 (down three)</td>
<td>18</td>
</tr>
<tr>
<td>Hospital Associated Cases currently in hospital</td>
<td>5 (down two) *reclassification</td>
<td>5 (no change)</td>
<td>10</td>
</tr>
<tr>
<td>Community acquired/other cases currently in hospital</td>
<td>4 (down one) *reclassification</td>
<td>4 (down three)</td>
<td>8</td>
</tr>
<tr>
<td>Deaths related to outbreak</td>
<td>25</td>
<td>4</td>
<td>30</td>
</tr>
</tbody>
</table>

* The Community/other category, non-hospital associated cases includes community, relapses, reoccurrences and colonized (previous history of C. difficile) cases.

** Due to the complexity in examining and categorizing each case by the infection prevention and control staff, we are no longer in a position to report changes that take place over the weekend. These cases will be reviewed Monday and reported as soon as possible following the weekend. We will continue to report daily on changes that take place through the week and are committed to providing updates that are significant in nature on weekends.

*** Beginning Wednesday, Sept. 7, more than 30 days since the outbreak was declared over at the Welland Site, we will report cases at this site similar
Disinfecting Model

- Based on the ability of registered products claims to kill or inactivate specific pathogens or category of pathogens.
- Proven in laboratory test and accepted by regulatory bodies.
- Provides institutions with assurance that they are providing a safe environment for staff and patients?
Disinfecting Model

Generic disinfectants reviewed and accepted by Health Canada as acceptable for specific uses ie Health Care, institution, household.

Pathogen specific disinfectants with specific claims from bacteria, viruses to bacterial spores.
Disinfecting model

• Use of disinfectants has not reduced the rates of hospital acquired infections in fact the rates are increasing.

• Our understanding of microbes is increasing and disinfectants may not be effective.
Disinfection: is it time to reconsider Spaulding?

G. McDonnell, P. Burke

ARTICLE INFO

Article history:
Received 17 April 2011
Accepted 6 May 2011
by J.A. Child
Available online 8 June 2011

SUMMARY

The Spaulding classification, originally proposed in 1957, is a widely used system for matching the disinfection and sterilization of surfaces, particularly those of re-usable medical/surgical devices, with available processes. It presents a ranking, from simple disinfection through to sterilization, that should be considered in the reprocessing of devices, based on the risks associated with their use, ranging from ‘critical’ (presenting a high risk), through ‘semi-critical’ to ‘non-critical’ (presenting a low risk). The different levels of disinfection are based on demonstrating antimicrobial activity against established marker micro-organisms representing a range of pathogens. Although this classification system is probably as valid today as it was in 1957, the understanding of microbiology and micro-organisms has changed. This article discusses some examples of disinfection studies with viruses, bacteria, protozoa and prions that challenge the current definitions and expectations of high-, intermediate- and low-level disinfection. In many of these examples, the test micro-organisms demonstrate atypical tolerance or resistance profiles to disinfection processes. In addition to laboratory-based studies, there is now clinical evidence for at least some of these micro-organisms that biocide resistance can lead to infection outbreaks due to unexpected disinfection failure. These reports should encourage the reader to challenge current dogma, and reconsider the expectations of disinfection and sterilization practices.

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The resistance profiles of other non-enveloped viruses (human and animal pathogens) have been investigated recently. These include parvoviruses, coxsackieviruses, other enteroviruses, hepatitis A virus and noroviruses. Disinfection studies have shown that some of these viruses are distinctly more resistant than the poliovirus marker, including thermal and chemical disinfection methods.
Infectious proteins: on the edge of microbiology

Prions, as infectious proteins and the causative agents in a group of diseases known as transmissible spongiform encephalopathies, are notable in their resistance to disinfection and sterilization.\(^1,60,61\) Initial studies on the inactivation of prions indicated that aggressive physical (steam sterilization at 134°C for 18 min) and chemical (1N NaOH or 2% available chlorine, in the form of sodium hypochlorite, for 1 h) methods were required, and this was recommended by the World Health Organization in 1999.\(^62\) Since this time, these methods have been tested on contaminated surfaces and found to be effective (although associated infectivity is not always removed completely), but damage numerous types of devices.\(^61,63\) At the same time, relatively simple cleaning processes can be effective against prions without broad-spectrum antimicrobial activity.
Infectious proteins: on the edge of microbiology

<table>
<thead>
<tr>
<th>Disease</th>
<th>Associated protein precipitation</th>
<th>Evidence of transmissibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alzheimer’s disease</td>
<td>Amyloid β-peptide and Tau</td>
<td>Experimental evidence</td>
</tr>
<tr>
<td>Parkinson’s disease</td>
<td>α-Synuclein</td>
<td>No evidence</td>
</tr>
<tr>
<td>Cataracts</td>
<td>Crystallins</td>
<td>No evidence</td>
</tr>
<tr>
<td>Systemic amyloidosis</td>
<td>Amyloid-A and apolipoprotein</td>
<td>Experimental evidence</td>
</tr>
<tr>
<td></td>
<td>All amyloid</td>
<td>suggests a potential transmissible/acceleration nature</td>
</tr>
</tbody>
</table>

Cleaning Model

- Physical removal of organic soils including pathogens of all types.
- Many countries have discontinued use of disinfectants for cleaning.
- Bacteria cannot multiply on clean dry surfaces.
- Frequent and effective cleaning of the near patient environment prevents spreading pathogens.
Cleaning Model

Is there any evidence cleaning can remove C. difficile spores from the environment?
Assessing the efficacy of different microfibre cloths at removing surface micro-organisms associated with healthcare-associated infections

D.L. Smith a, S. Gillanders b, J.T. Holah a, C. Gush c

a Campden BRI, Department of Food Hygiene, Chipping Campden, Gloucestershire, UK
b Centre for Evidence-based Purchasing, NHS Purchasing and Supply Agency, London, UK
c Department of Health, London, UK

ARTICLE INFO

Article history:
Received 27 September 2010
Accepted 25 February 2011
by S.J. Dancer
Available online 17 April 2011

Keywords:
Cleaning
Healthcare-associated infection
Microfibre

SUMMARY

This study investigated the ability of 10 different microfibre cloths to remove microbial contamination from three surfaces commonly found in hospital settings (stainless steel, furniture laminate and ceramic tile), under controlled laboratory conditions. Tests were conducted using organisms known to cause healthcare-associated infections, i.e. meticillin-resistant Staphylococcus aureus (MRSA), Clostridium difficile (in spore form) and Escherichia coli.

For all the cloths tested, there was significant statistical evidence to suggest a difference in cleaning performance between them on first and single use \((P < 0.001)\). However, the overall performance of the nine re-useable cloths did not differ in practice with differences in \(\log_{10}\) reductions of \(<1\). The performance of the disposable microfibre cloth was notably worse. The performance of all cloths decreased with repeated use on a succession of contaminated surfaces. After repeated washing, re-usable cloth performance improved at 75 washes, and reduced after 150 washes, although, in most instances, performance after 150 washes was better than at first wash. For all cloths, price was not an indication of performance. Based on these laboratory findings, it is concluded that use of the microfibre cloths investigated is an effective way to reduce the levels of MRSA, E. coli and C. difficile (in spore form) on a range of surfaces found in the clinical environment and could therefore be of benefit to these environments.

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Results

For overall mean log_{10} reductions, achieved on single use of a cloth, for all test organisms, by surface and cloth type, ANOVA suggested that there was significant evidence of a difference between cloth (P < 0.001) and micro-organism type (P < 0.001). The evidence of a difference for surface material was marginally below the critical 95% confidence level (P = 0.072), but there was significant evidence

The results for the mean number of C. difficile (log_{10} reduction, cfu) removed from furniture laminate on repeat washing of single cloths are shown in Figure 3. For all data, ANOVA suggested that there was significant evidence of a difference between cloth (P < 0.001) and number of washes (P < 0.001). Microbial removal was greater for the majority of cloths after 75 washes (and 50 washes for JD Taski Micro Light, and 100 washes for JD Micro Easy) than after a single wash, with a slight decline in 75 wash performance by most

Figure 1. Mean number of bacteria (log_{10} reduction, cfu) removed from all surface types by each microfibre cloth.
Assessing the efficacy of different microfibre cloths at removing surface micro-organisms associated with healthcare-associated infections

It is recommended that manufacturers’ instructions on the preparation, use and washing of the cloths should always be followed in order to maximize cloth performance.
PCS Bundle

- PCS Micro Fiber Cloths
- PCS Decontamination/ laundering process
- PCS Validated cleaning process.
### SAMPLE PROCESS:

<table>
<thead>
<tr>
<th>BUCKET USAGE AND COLOR</th>
<th>PRODUCT USED</th>
<th>BUCKET SIZE</th>
<th>CLOTHS</th>
<th>AVAILABLE COLORS</th>
<th>CHARGING VOLUME</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLEANING “C”</td>
<td>MICROCLEAN</td>
<td>1.5 GALLON</td>
<td>15</td>
<td></td>
<td>1.5 QUARTS</td>
</tr>
<tr>
<td>DISINFECTING “D”</td>
<td>PCS 1000</td>
<td>2.5 GALLON</td>
<td>25</td>
<td></td>
<td>2.6 QUARTS</td>
</tr>
<tr>
<td>SOILED CLOTHS</td>
<td>NONE</td>
<td>1.5 OR 2.5 GALLON</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SOILED CLOTHS</td>
<td>NONE</td>
<td>5.5 GALLON</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### PROCESS:

Place the folded color coded cloths into their respective buckets. You will need enough cloths (and buckets) to clean, and where required disinfectant for the day. You will also need a bucket to carry the soiled cloths.

Moisten your cleaning cloths “C” with MicroClean

Take a Cleaning “C” cloth and fold it into 4

Begin by wiping the surface in one direction, then wipe in the other.
HOSPITAL CLEANING VALIDATION

Process Cleaning Solutions is committed to providing evidence based cleaning practices.

Many recent publications have presented evidence cleaning in health care facilities is less than optimal with some reporting as little as 50% of surfaces being cleaned to desired levels.

Converting to best practices or embracing cleaning process changes to improve outcome results in cleaner safer health care facilities.

PCS Health Care cleaning practices for acute and long term care facilities recommendations includes cleaning surfaces with micro fiber cloths dampened in a diluted solution of PCS Process MicroClean in a charge bucket.

Where required, apply PCS Oxidizing Disinfectant/Disinfectant Cleaner diluted from concentrate DIN 02356090 or DIN 02314878 PCS 1000 Oxidizing Disinfectant/Disinfectant Cleaner ready to use. Both are registered as generic Sodium Hypochlorite hospital grade disinfectants at 1000ppm (parts per million)

To provide evidence as to the efficacy of the PCS hospital cleaning and disinfecting process, PCS works closely with acute
ATP tests were performed before cleaning, after cleaning and again after the application of PCS 1000ppm Hypochlorite Disinfectant.

10 microbial surface tests with RODAC plates were done before cleaning, after cleaning and after application of the disinfectant.

A total of 54 ATP test and 180 rodac plate test for aerobic bacteria counts where performed.

Aerobic bacterial counts where reduced 98% from pre cleaning values. ATP counts where reduced by 92% from pre cleaning values.
## Hospital Cleaning Validation

### Room B736

**Before cleaning**
- ATP average of three readings: 157
- Microbial average of ten plates: 75 CFU (colony forming units)

**After Cleaning**
- ATP average of three readings: 13
- Microbial average of ten plates: 16

**After application of PCS 1000**
- ATP average of three readings: 1
- Microbial average of ten plates: 0.9

### Room B641

**Before Cleaning**
- ATP average of three readings: 376
- Microbial average of ten plates: 166

**After cleaning**
- ATP average of three readings: 19
- Microbial average of ten plates: 59

**After application of PCS 1000**
- ATP average of three readings: 0.3
- Microbial average of ten plates: 0.4

### Room B631

**Before cleaning**
- ATP average of three readings: 125
- Microbial average of ten plates: 26

**After cleaning**
- ATP average of three readings: 31.6
- Microbial average of ten plates: 35.6

**After application of PCS 1000**
- ATP average of three readings: 11
- Microbial average of ten plates: 4.8

### Room 407

**Before cleaning**
- ATP average of three readings: 149
- Microbial average of ten plates: 49.2

**After cleaning**
- ATP average of three readings: 53.6
- Microbial average of ten plates: 30.9

**After application of PCS 1000**
- ATP average of three readings: 40.6
- Microbial average of ten plates: 0.2
The results from these acute care facilities validate the effectiveness of the PCS process and provide very good correlation in results from ATP testing and aerobic plate counts.

PCS continues to support ongoing monitoring utilizing ATP testing as a very valuable tool for training staff and validating process. The aerobic RODAC plate tests provide good evidence that multiple staff can achieve excellent results when using an effective validated cleaning process.

**Aerobic bacteria counts where reduced 98 percent from pre cleaning values.**

**ATP where reduced by 92 percent from pre cleaning values.**
C. difficile as a Cleaning Problem
New Deep Cleaning Process Beats Disinfection

PCS is proud to introduce our new MicroClean Deep Cleaning Process, which promises to change the industry's view on cleaning and disinfection. In a nutshell, removing bacteria beats trying to kill them.

Disinfectants works by killing bacteria and bacterial spores, and are required to meet high standards of killing or inactivating pathogens in order to become registered as hard surface disinfectants or sporicides. Deep cleaning works by physical removal of the same pathogens from environmental surfaces. Our new MicroClean process has been independently validated to physically remove soil, bacteria and bacterial spores to levels equal to or better than those that disinfectants are required to kill or inactivate.

MicroClean Deep Cleaning Process validation testing by independent third party laboratory demonstrated physical removal of 99.9999% (a ‘six log’ reduction) of bacteria and bacterial spores in the presence of artificial soil, with all post cleaning tests having no reported colony growth. By contrast, when an international brand disinfecting bleach diluted 10 to 1 was wiped over the same surface for a soil and bacterial spore challenge, it was not able to completely remove all the spores or to achieve the required six log reduction of spores on all post application tests.

How can cleaning beat disinfection? We have known for a long time that hand washing following proper procedures is the most effective method of controlling the spread of bacterial spores such as C difficile. Hand washing works by physically removing bacteria and bacterial spores. We developed the MicroClean Deep Cleaning Process to create a process of physical removal similar to hand washing, but applicable to environmental surfaces. We accomplish it with a unique natural cleaning solution which acts synergistically when combined with new microfibre cleaning technology in a carefully ordered cleaning process.

The MicroClean Deep Cleaning Process

1. Application to surface
   - MicroClean is diluted 20 parts water to 1 part cleaner.
   - Spray or apply MicroClean to surface.
   This step dissolves soil and loosens adhered bacteria, bacterial spores and soil.

2. Application of friction and removal / rinsing
   - Take pre dampened PCS Microfibre cloth with a solution of MicroClean diluted 256 parts water with 1 part cleaner, and wipe surface in two directions, adding friction.
   This step physically removes soil, bacteria and bacterial spores.

3. Thorough drying of surface
   - Use a dry PCS microfibre cloth and wipe surfaces dry.
   This step physically removes residual soil, bacteria and bacterial spores.

Summary

More thorough and complete cleaning of environmental surfaces is safer, more sustainable and ironically more effective than relying on application of disinfectants to provide complete environmental decontamination. Removing bacteria first always makes sense.
SAMPLE IDENTIFICATION

Company: Process Cleaning Solutions Ltd.
Location: Peterborough ON
Substance: PCS MicroClean Deep Cleaning Process
Chemical Lot Number: Not given
Sample Description: Clear green liquid with no odour.
Method: PCS MicroClean Deep Cleaning Process Validation Test

Sample Type: Chemical
Submitted By: M. Rochon
Date Received: 2011-06-28
Date Tested: 2011-07-19

TEST RESULTS

Demonstrates a >6 log reduction in viable counts in-vivo test against a single indicator organism.

TEST DATA

Prevalues

<table>
<thead>
<tr>
<th>Replicate</th>
<th>Dilution</th>
<th>Mean x 10^4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10^-4</td>
<td>10^-5</td>
</tr>
<tr>
<td>1</td>
<td>277</td>
<td>27</td>
</tr>
<tr>
<td>2</td>
<td>250</td>
<td>26</td>
</tr>
<tr>
<td>3</td>
<td>242</td>
<td>34</td>
</tr>
</tbody>
</table>

Prevalue Mean: 2.7 x 10^6

Postvalues

<table>
<thead>
<tr>
<th>Replicate</th>
<th>Dilution</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10^-9</td>
<td>10^-4</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Postvalue Mean: 0

TEST CONDITIONS

Challenge Organism: Bacillus subtilis
Initial Titre: 2.7 x 10^6
Soil Load: 6 g/L bovine serum albumin - simulated dirty conditions
Culture Application: 0.1 ml of inoculum spread over 1 inch square and dried for 1 hour at 35°C
Test Surface: 1380 cm^2 stainless steel surface
SAMPLE IDENTIFICATION

Company: Process Cleaning Solutions Ltd.  
Location: Peterborough  
Substance: PCS MicroClean Deep Cleaning Process  
Chemical Lot Number: Not given  
Sample Description: Clear green liquid with no odour.  
Method: PCS MicroClean Deep Cleaning Process Validation Test

TEST RESULTS

Demonstrates a 7 log reduction in viable counts in-vivo test against multiple indicator organisms.

TEST DATA

<table>
<thead>
<tr>
<th>Prevalues</th>
<th>Replicate</th>
<th>Dilution</th>
<th>Mean x 10^4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>1 x 10^7</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>1</td>
<td>1 x 10^6</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>1</td>
<td>1 x 10^5</td>
</tr>
</tbody>
</table>

Prevalue Mean: 9.5 x 10^7

<table>
<thead>
<tr>
<th>Postvalues</th>
<th>Replicate</th>
<th>Dilution</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>10^9</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>10^8</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>10^7</td>
<td>0</td>
</tr>
</tbody>
</table>

Postvalue Mean: 0

TEST CONDITIONS

Challenge Organism: Escherichia coli, Staphylococcus aureus, Pseudomonas aeruginosa
Initial Titre: 9.5 x 10^7
Soil Load: 6 g/L bovine serum albumin - simulated dirty conditions
Culture Application: 0.1 ml of inoculum spread over 1 inch square and dried for 1 hour at 35°C
Test Surface: 1380 cm² stainless steel surface
AQUATOX
AquaTox Testing & Consulting Inc.
11B Nicholas Beaver Rd.
RR 3
Guelph ON N1H 6H9
Tel: (519) 763-4412 Fax: (519) 763-4419

Work Order: 219413
Sample Number: 31082

SAMPLE IDENTIFICATION
Company: Process Cleaning Solutions Ltd.
Location: Peterborough ON
Substance: Chlorox Bleach
Chemical Lot Number: Not given
Sample Description: Clear, yellow liquid with strong odour
Method: PCS MicroClean Deep Cleaning Process Validation Test
Sample Type: Chemical
Submitted By: M. Rochon
Date Received: 2011-06-28
Date Tested: 2011-07-19

TEST RESULTS
Demonstrates a >5 log reduction in viable counts in-vivo test against a single indicator organism.

TEST DATA
Prevalues

<table>
<thead>
<tr>
<th>Replicate</th>
<th>Dilution</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10^-4</td>
<td>10^-5</td>
</tr>
<tr>
<td>1</td>
<td>247</td>
<td>23</td>
</tr>
<tr>
<td>2</td>
<td>234</td>
<td>24</td>
</tr>
<tr>
<td>3</td>
<td>NA</td>
<td>18</td>
</tr>
</tbody>
</table>

Prevalue Mean: 2.2 x 10^6

Postvalues

<table>
<thead>
<tr>
<th>Replicate</th>
<th>Dilution</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10^9</td>
<td>10^-4</td>
</tr>
<tr>
<td>1</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Postvalue Mean: 3.3

TEST CONDITIONS
Challenge Organism: Bacillus subtilus
Initial Titre: 2.2 x 10^6
Soil Load: 6 g/L bovine serum albumin - simulated dirty conditions
Culture Application: 0.1 ml of inoculum spread over 1 inch square and dried for 1 hour at 35°C
Test Surface: 1380 cm^2 stainless steel surface

MICROCLEAN DEEP CLEANING PROCESS DESCRIPTION
The test surface was sampled prior to cleaning to obtain pre-values and assess initial titre. A solution of Chlorox Bleach was prepared in water at 1:10 dilution. The solution was applied using a spray bottle covering the test surface. The test surface
## Product Review - Review ATP Levels Pre & Post Clean

### Hygiena ATP monitoring

<table>
<thead>
<tr>
<th>C-Diff Positive Patient Room</th>
<th>Prior to Cleaning</th>
<th>After Cleaning with MicroClean** @1030</th>
<th>Resulting Change</th>
<th>After Bleach @1330</th>
<th>Resulting Change</th>
<th>Bio Burden @1630</th>
<th>Resulting Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Bed Rail</td>
<td>301</td>
<td>57</td>
<td>-244</td>
<td>4</td>
<td>-53</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>2 Overbed Table</td>
<td>1238</td>
<td>61</td>
<td>-1177</td>
<td>7</td>
<td>-54</td>
<td>18</td>
<td>11</td>
</tr>
<tr>
<td>3 Call Button</td>
<td>1237</td>
<td>19</td>
<td>-1216</td>
<td>14</td>
<td>-6</td>
<td>119</td>
<td>103</td>
</tr>
<tr>
<td>4 Toilet Seat (top and bottom)</td>
<td>41</td>
<td>6</td>
<td>-35</td>
<td>0</td>
<td>-6</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5 Light Switch/ Sink/ Flusher</td>
<td>554</td>
<td>7</td>
<td>-547</td>
<td>0</td>
<td>-7</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Average ATP = 674

**New microfibre**

### VRE Positive Patient Room

<table>
<thead>
<tr>
<th>Prior to Cleaning Day 1</th>
<th>After Cleaning with Virox* @1030</th>
<th>Resulting Change</th>
<th>Prior to Cleaning Day 2</th>
<th>After Cleaning with MicroClean** @1030</th>
<th>Resulting Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Bed Rail</td>
<td>400</td>
<td>134</td>
<td>266</td>
<td>19</td>
<td>-245</td>
</tr>
<tr>
<td>2 Overbed Table</td>
<td>35</td>
<td>30</td>
<td>17</td>
<td>24</td>
<td>7</td>
</tr>
<tr>
<td>3 Call Button</td>
<td>21</td>
<td>10</td>
<td>37</td>
<td>32</td>
<td>-5</td>
</tr>
<tr>
<td>4 Toilet Seat (top and bottom)</td>
<td>48</td>
<td>2</td>
<td>14</td>
<td>7</td>
<td>-7</td>
</tr>
<tr>
<td>5 Light Switch/ Sink/ Flusher</td>
<td>142</td>
<td>27</td>
<td>9</td>
<td>12</td>
<td>3</td>
</tr>
</tbody>
</table>

**New microfibre**

**Average ATP = 129**

**Old microfibre**

Average ATP = 66.5

**Pass**
MicroClean Deep Cleaning Process round two of Aquatox testing.
Bacillus subtilis ATCC 19659 commonly used for sporicidal testing.

After discussions with various experts in the field a second round of testing was initiated to provide additional validation of the process.

Round two of laboratory testing included ten repeat test sites, an additional test with PCS Micro fibre cloth dampened with water only and one wipe with friction applied and the last added test was to see if spores could be transferred from bleach soaked cloth after wiping contaminated surfaces.

Results

- PCS microfibre cloth dampened with water only one wipe with friction applied.
- Demonstrated a 99.97% reduction with 5 of the ten test sites showing growth post application.
- With a geometric mean of growth of 7.30

- Clorox disinfectant bleach test with 10 parts water to 1 part bleach. Surface was sprayed with bleach solution and then wiped with PCS microfibre cloth single wipe normal pressure.
- Demonstrated a 99.98% reduction with 7 of ten test sites showing growth post application,
- With a geometric mean of growth of 7.52

- MicroClean Deep Cleaning Process 20 to 1 dilution of MicroClean was sprayed on surface then wiped with a dampened PCS microfibre cloth once applying friction followed by wiping surface dry with a separate dry PCS microfibre cloth.
- Demonstrated a 99.99% reduction with 1 of ten test sites showing growth.
- With a geometric mean of growth of 1.26

- PCS microfibre cloth saturated with 10 to 1 bleach solution which was used to wipe contaminated surface was used to wipe a clean surface to measure the potential for bleach soaked cloth to transfer test organism.
- One of ten test sites showing growth.
- Geometric Mean of Growth of 1.26
SAMPLE IDENTIFICATION

Company: Process Cleaning Solutions Ltd.  Sample Type: Chemical
Location: Peterborough ON  Submitted By: M. Rochon
Substance: PCS MicroClean Deep Cleaning Process  Date Received: 2011-06-28
Chemical Lot Number: Not provided  Date Tested: 2011-09-02
Sample Description: Clear green liquid with no odour.
Method: PCS MicroClean Deep Cleaning Process Validation Test

TEST RESULTS

Demonstrates a 99.99% reduction in viable counts in-vivo test against a single indicator organism.

TEST DATA

**Prevalues**

<table>
<thead>
<tr>
<th>Replicate</th>
<th>Dilution</th>
<th>Dilution</th>
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<td>55/47</td>
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<td>3</td>
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Geometric Mean of Initial Titre: $5.6 \times 10^{-4}$

**Postvalues**

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<th>Dilution</th>
<th>Dilution</th>
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Geometric Mean of Growth: 1.26

TEST CONDITIONS

Challenge Organism: Bacillus subtilis ATCC 19659
Soil Load: 6 g/L bovine serum albumin - simulated dirty conditions
Culture Application: 0.1 ml of inoculum spread over 1 inch square and dried for 1 hour at 35°C
Test Surface: 1380 cm² stainless steel surface
SAMPLE IDENTIFICATION

Company: Process Cleaning Solutions Ltd.
Location: Peterborough ON
Substance: Tap Water
Chemical Lot Number: Not applicable
Sample Description: Clear, colourless, odourless liquid.

Sample Type: Not applicable
Submitted By: AquaTox
Date Received: 2011-07-13
Date Tested: 2011-07-13

Method: PCS MicroClean Deep Cleaning Process Validation Test

TEST RESULTS

Demonstrates a 99.97% reduction in viable counts in-vivo test against a single indicator organism.

TEST DATA

Prevalues

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<tr>
<th>Replicate</th>
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<th>$10^{-5}$</th>
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<td>12 sp/15sp</td>
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Geometric Mean of Initial Titre: $2.6 \times 10^{-4}$

Postvalues

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Geometric Mean of Growth: 7.30

TEST CONDITIONS

Challenge Organism: *Bacillus subtilis* ATCC 19659
Soil Load: 6 g/L bovine serum albumin - simulated dirty conditions
Culture Application: 0.1 ml of inoculum spread over 1 inch square and dried for 1 hour at 35°C
Test Surface: 1380 cm² stainless steel surface

MICROCLEAN DEEP CLEANING PROCESS DESCRIPTION
SAMPLE IDENTIFICATION

Company: Process Cleaning Solutions Ltd.  Sample Type: Chemical
Location: Peterborough ON  Submitted By: Not applicable
Substance: Chlorox Bleach  Date Received: Not applicable
Chemical Lot Number: Not applicable  Date Tested: 2011-07-19
Sample Description: Clear, yellow liquid with strong odour.
Method: PCS MicroClean Deep Cleaning Process Validation Test

TEST RESULTS

Demonstrates a 99.98% reduction in viable counts in-vivo test against a single indicator organism.

TEST DATA

Prevalues

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<td>43/45</td>
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Geometric Mean of Initial Titre: 4.6 x 10^-4

Postvalues

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<th>Dilution</th>
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</tr>
<tr>
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<td>1</td>
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<td>4</td>
</tr>
</tbody>
</table>

Geometric Mean of Growth: 7.52

TEST CONDITIONS

Challenge Organism: Bacillus subtilis ATCC 19659
Soil Load: 6 g/L bovine serum albumin - simulated dirty conditions
Culture Application: 0.1 ml of inoculum spread over 1 inch square and dried for 1 hour at 35°C
Test Surface: 1380 cm² stainless steel surface

MICROCLEAN DEEP CLEANING PROCESS DESCRIPTION
Work Order : 219413  
Sample Number : 31082  

SAMPLE IDENTIFICATION  
Company : Process Cleaning Solutions Ltd.  
Location : Peterborough ON  
Substance : Cross Contamination  
Chemical Lot Number : Not applicable  
Sample Description : Not applicable  
Method : PCS MicroClean Deep Cleaning Process Validation Test  
Sample Type : Not applicable  
Submitted By : Not applicable  
Date Received : Not applicable  
Date Tested : 2011-09-02  

TEST DATA  

<table>
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<th>1.0 mL</th>
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<tr>
<td>5</td>
<td>0</td>
<td>10</td>
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</tr>
</tbody>
</table>

Geometric Mean of Growth : 1.26  

TEST CONDITIONS  

Challenge Organism : Bacillus subtilis ATCC 19659  
Initial Titre : Clean surface  
Soil Load : No intended soil load  
Culture Application : No culture applied  
Test Surface : 1380 cm² stainless steel surface  

MICROCLEAN DEEP CLEANING PROCESS DESCRIPTION  

A clean test surface demarcated with ten 1 cm² test areas was prepared prior to testing. Immediately after wiping the bleach testing surface with the cloth soaked in bleach, the same cloth was used to wipe the uncontaminated, clean surface. The surface was then sampled for post cleaning values immediately after wiping to assess cross contamination activity.
Spread and persistence of Clostridium difficile spores during and after cleaning with sporicidal disinfectants

Table 1
Number of Clostridium difficile spores recovered from surfaces sampled immediately \( (t = 0) \) or 60 min \( (t = 60) \) after being cleaned with a microfibre cloth with or without a sporicidal disinfectant \( (N = 5) \)

<table>
<thead>
<tr>
<th></th>
<th>Mean (SD) number of spores recovered from surface (log cfu/25 cm²; ( N = 5 ))</th>
<th>Tap water (control)</th>
<th>Chlorine-dioxide-generating sporicide</th>
<th>Chlorine-releasing sporicide</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( t = 0 )</td>
<td>( t = 60 )</td>
<td>( t = 0 )</td>
<td>( t = 60 )</td>
</tr>
<tr>
<td>Surface after cleaning</td>
<td>3.58 (0.18)</td>
<td>3.20 (0.16)</td>
<td>4.07 (0.24)</td>
<td>4.34 (0.20)</td>
</tr>
<tr>
<td>First consecutive transfer</td>
<td>3.48 (0.28)</td>
<td>3.26 (0.13)</td>
<td>3.73 (0.34)</td>
<td>3.15 (0.16)</td>
</tr>
<tr>
<td>Second consecutive transfer</td>
<td>3.15 (0.16)</td>
<td>3.30 (0.17)</td>
<td>3.72 (0.41)</td>
<td>3.26 (0.13)</td>
</tr>
<tr>
<td>Third consecutive transfer</td>
<td>3.20 (0.22)</td>
<td>3.15 (0.16)</td>
<td>3.85 (0.51)</td>
<td>3.08 (0.13)</td>
</tr>
<tr>
<td>Fourth consecutive transfer</td>
<td>3.20 (0.16)</td>
<td>3.08 (0.13)</td>
<td>3.41 (0.33)</td>
<td>3.08 (0.13)</td>
</tr>
</tbody>
</table>

cfu, colony-forming units; SD, standard deviation.

However, when tested under practical in-use conditions, they failed to prevent the transfer of spores during cleaning, and failed to achieve a 3 log reduction in residual spore numbers after 60 min.

Our findings support those of others, and suggest that current validation standards used for the development of commercially available sporicides do not accurately reflect in-use practices. Healthcare practitioners should take precautions to ensure that existing disinfectants have in-use sporicidal activity against C. difficile spores.

Conflict of interest statement
None declared.

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S. Ali
G. Moore
A.P.R. Wilson
Department of Microbiology, University College London Hospitals, London, UK

* Corresponding author. Address: UCLH Environmental Research Group, Department of Medical Microbiology, Royal Free Hampstead NHS Trust, Pond Street, London, NW3 2QG, UK.
Tel.: +44 (0) 207794 0500 Ext. 31152; fax: +44 (0) 207 317 7710.
Discussion
The benefits of the PCS bundle approach to cleaning provides benefits to consumers in all markets from cleaning the most serious pathogens in health care facilities to keeping public facilities as clean as possible within the limited resources available today.

The PCS Bundle

Cleaning Cloths
PCS microfibre cloths are designed to pick up and hold large volume of soils including bacterial spores therefore removing them from the environment. The PCS microfibre cloths are designed to minimize the transfer of pathogens from cleaning cloth to surface by trapping soil which includes microbial contamination between the fibres. Some microfibre cloths have demonstrated that they easily transfer very high numbers of pathogens from surface to surface even when used with sporicidal products.

Laundering/ reprocessing of cleaning cloths.
Most facilities using microfibre cloths never achieve the full benefit of using microfibre cloths because the laundry process used is not completely affective at releasing all of the soils attached to cloths or they imbed cloths with detergent residues that prevent soils from attaching to microfibres. PCS Process of removing trapped contamination from PCS and other microfibre cloths, using PCS MicroLaundry and PCS Destainer combined with a PCS validated laundry process allow for thorough removal of soils without imbedding cloths with chemical residues that prevent soils from attaching to microfibre cloths.

Cleaning Agent
Using PCS MicroClean for daily cleaning processes with PCS microfibre cloths allows for removal of organic soils which includes microbial contamination to low levels. When deeper and more complete cleaning is required The MicroClean Deep Cleaning Process maximizes the removal of organic soils including bacteria and bacterial spores. The process has repeatedly demonstrated the ability to reduce bacterial and bacterial spore contamination to levels that may not be achieved by wiping over surfaces with 10 to 1 bleach solution. Using MicroClean for Daily and Deep Cleaning provides added synergy to cleaning with microfibre cloths maximizing the benefits of microfibre cloths.

Validated Processes.
PCS provides a number of validated processes / procedures that help cleaning staff to achieve effective and repeatable reductions of microbial contamination of all kinds from the environment to levels considered safe. Effective cleaning of the environment protects public health. Application of disinfecting agents after cleaning should be considered as added insurance.

Antimicrobial stewardship programs should incorporate prudent application of disinfectants.